DOCUMENT RESUME

ED 474 725 SE 067 688

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TITLE	Problem? What Problem?
PUB DATE	2001-00-00
NOTE	12p.; In: Key Stage 3 Mathematics Teachers: The Current Situation, Initiatives and Visions. Proceedings of a National Day Conference. Open University, 2001. p47-57. For full document, see SE 067 440.
PUB TYPE	Reports - Research (143)
EDRS PRICE	EDRS Price MF01 Plus Postage. PC Not Available from EDRS
DESCRIPTORS	Foreign Countries; Higher Education; *Mathematics Education; Professional Development; *Teacher Recruitment; Teacher Selection; *Teacher Supply and Demand
IDENTIFIERS	*United Kingdom

ABSTRACT

Successive administrations have responded to the serious shortage of competent mathematics teachers by trying to 'make do', adopting short-term strategies which fail to address the underlying problem. A sense of urgency, the will to act, and the imagination to see a way forward have been absent. The situation is now worse than ever. This paper offers a preliminary analysis based on three distinct headings: (1) recruitment; (2) retention; and (3) re-training. Each requires emergency short-term measures and a long-term strategy that must be compatible. Analysis leads to a number of conclusions and practical proposals. (Author/KHR)

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Problem? What Problem?

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Abstract

Successive administrations have responded to the serious shortage of competent mathematics teachers by trying to 'make do', or by adopting short-term strategies which fail to address the underlying problem. A sense of urgency, the will to act, and the imagination to see a way forward have been absent. The situation is now worse than ever. I offer a preliminary analysis based on the three distinct headings - (a) Recruitment, (b) Retention, and (c) Re-training. Though distinct, these remain interdependent (so should not be separated as in the DfES!). Each requires emergency short-term measures, and a long-term strategy - which must be compatible. My analysis leads to a number of conclusions and practical proposals. If these survive initial scrutiny, some could be implemented almost immediately, while others would require some preparatory work.

General background

There are times in life when it is hard not to despair. For those who care about mathematics, about schools, about teachers and about children, now would appear to be such a time.

Raising the quality of mathematics in schools depends to some extent on achieving a sound curriculum and on adequate resources. But above all it depends on having competent teachers, and on providing them with the 'space' which they need to teach well.

Education is based on a simple premise: since fashion is fickle, and since the present lasts no longer than the twinkling of an eye, the things worth passing on are those which have proved themselves to be of lasting value. Thus education has to be seen as a long-term venture, in which we lay foundations in the early years with a clear understanding of what will later be developed thereon. In particular, while the adult world may undergo change at an increasing rate, the education of our children cannot take place in a climate of continual upheaval.

The recent DEMOS report by Matthew Horne (Horne, 2001), which asserted that 'teaching has become an unsustainable profession', also notes that:

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> Contrary to popular opinion, teachers are not resistant to change in all forms… However, most teachers argued consistently that the government's education reforms meant that they had experienced change as a never-ending barrage of externally imposed and badly managed initiatives that they had little constructive role in helping to shape.

In mathematics the situation is sufficiently serious that graduates with good degrees scarcely give teaching a first thought, while experienced teachers are retiring early in droves - with or without an agreed early pension.

Against this background, the raft of initiatives and up-beat claims in the recent white paper, *Schools: achieving success* (DfES 2001), contains more than a hint of the Queen of Hearts, croquet hoops and balls apparently in place, proceeding to declare the start of yet another inevitably victorious game, while failing to notice that the balls and hoops have all uncurled themselves, stood up, and wandered off.

In trying to make sense of the current mess, it may help to distinguish two separate issues.

First there is the (largely political) problem of acknowledging, and responding appropriately to, the short-term chronic shortage of mathematics teachers.

Second there is the professional challenge (facing the DfES, the TTA, and those from the wider mathematics and education communities in schools and universities) of devising some way to make sure that the short-term crisis does not become accepted as an intrinsically insoluble recurring theme.

One reason for making this distinction is the need to insist (i) that the two problems have to be tackled simultaneously, even if the first requires action on a shorter time-scale, and (ii) that no proposed response to the short-term political problem should be adopted if it seems likely to undermine progress in addressing the longer-term challenge.

Our discipline of Mathematics is a remarkable and increasingly important part of human life and culture. Thus we have to find ways of ensuring that those with the abilities and the inclination to teach mathematics in schools are encouraged to consider it seriously, without their being required to put up with working conditions

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which make it increasingly difficult to gain the simple satisfaction that comes from teaching mathematics effectively.

My main aim here is to attempt a thumbnail sketch of the longer-term challenge facing the profession. However, it is necessary first to indicate the extent to which inadequate and inappropriate responses to the short-term 'political' problem regularly undermine attempts to address the more serious long-term issue.

Recent events

The serious shortage of competent mathematics teachers has been evident for more than a decade. According to the DfE's own data [DfE Statistical Bulletin 24/93] a survey in January 1992 showed that less than 40% of those teaching mathematics in maintained secondary schools had a qualification (specialist degree or B.Ed.) involving an (unspecified) 'significant amount of mathematics'. When one allows for the fact that the corresponding figure for those teaching mathematics at age 16-19 was over 70%, it was evident that

> already in the early 1990s the percentage of mathematically qualified teachers at Key Stage 3 was embarrassingly low (around 25%),
>
> Ministers and officials were well aware of this fact, and that they chose to muddle through.

Those of us who sought to persuade the TTA to act were repeatedly confronted with a wall of ever more bizarre excuses as to why the problem was 'intrinsically insoluble'. The issue was further highlighted in the 1995 LMS report *Tackling the mathematics problem* (Appendix F). Yet, in seeking an accurate analysis of the nature of the problem, and an assessment of how it might best be addressed, Ministers and officials have consistently failed to engage in any kind of dialogue with the relevant sections of the mathematics and education communities.

Radical changes in schools continue to be rushed through without considering their inevitable impact on mathematics and on the supply and retention of mathematics teachers. And there appears to be no coherent strategy for systematically

strengthening the mathematical competence of the tens of thousands of serving mathematics teachers who have a relatively weak mathematical background.

Not surprisingly, the situation has worsened.

From the outside it can sometimes seem that officials have become intoxicated by their own 'virtual' (= unreal) world of education. The future offers many exciting possibilities (of which 'curriculum online' may well be one). But all of these possibilities require more, and more competent, mathematics teachers. It is therefore worrying to find such possibilities being bandied about as though they offered some magic solution to the problem of teacher shortage. Instead of engaging with those who might help to solve the problem, the official 'virtual' world, with its consistently up-beat 'spin', is in danger of sliding into the Soviet-style belief that all problems can be resolved through central Diktat alone.

Though there are one or two more positive signs, the overall impression is that the government and its officials need to be reminded of that most basic of all principles: when in a hole, stop digging, make an honest attempt to take stock, and look for the most likely sources of help! In this respect the long-delayed white paper *Schools: achieving success* would seem to represent a missed opportunity. A whole chapter is devoted to 'Valuing and supporting teachers in schools'; but its tone and detail gives the impression that the authors have got hold of the wrong end of the stick (or even the wrong stick entirely).

The central issue was highlighted in the recent DEMOS report - cited above: 'Schools need to become more appealing places to work', so that teachers are systematically helped to become competent professionals, and so that the best teachers are content to continue in the profession.

As indicated by the 1992 data quoted above, any partial solution to the long-term challenge will require a more profound, and a more professional, analysis than crude appeals to market carrot-and-stick financial packages (such as 'Golden Hellos' linked to penalty clauses designed to force recruits to stay in teaching). We have to find

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ways to improve the quality and the mathematical background of entrants to the profession, and to provide effective supplementary subject-based training for those already in post. In particular, any solution will depend on a level of co-operation and commitment from the profession, which is only conceivable on the basis of partnership. And such a partnership can in turn only be developed by actively engaging the profession in formulating, and hence securing their commitment to, whatever strategy is eventually adopted. Yet the recent white paper remains reluctant to confront the scale of the problem:

> 7.9 Shortages. ... there remain shortages in some parts of the country and some subjects and this can be a particular issue for schools facing challenging circumstances.

Though in pure logic 'some parts' is not inconsistent with 'almost everywhere', the intended impression here is clearly to suggest little more than a minor 'blip' on a largely progressive horizon. In reality, without an adequate critical mass of competent teachers, recent 'improvements' are unlikely to be sustained.

Her Majesty's Chief Inspector is renowned for his disarming directness. Yet, unlike his predecessor, he does not make a habit of pursuing his agenda in public. Thus one has to assume that he would not have made his very strong public pronouncement (reported on 29 August 2001) about the seriousness of the teacher shortage facing schools unless he felt that the issue was being ignored by those who are officially responsible.

HMCI's forthright public remarks were followed by a report in the Daily Telegraph (2 September) that the new Minister for Schools was having second thoughts. Whereas back in July he had tried to deflect any suggestion of a crisis (perhaps as a result of placing too much trust in the briefing provided by the civil servants in his new department), on 2 September he was reported as conceding:

> There are vacancies. There are very significant pressures in quite a number of schools in quite a number of parts of the country. Schools are facing great pressures. I have seen lots of evidence of that over the summer.

His language contrasts refreshingly with the white paper - even if the Secretary of State (in a BBC Radio 4 interview a day or two before) had been somewhat more restrained:

It is true there is a shortage. It is true that head teachers haven't had the choice that they wanted.

Sadly, from our point of view, the most striking thing about all these general remarks is that they do not begin to acknowledge, or to address the additional difficulties facing mathematics. However, we have to hope (and in this, this conference has the potential to serve as a valuable catalyst) that officials can be helped to understand not only the extent of the challenge facing us, but that they have to engage urgently in co-operative discussion with those sections of the wider mathematical community who must be an integral part of any long-term solution.

A very brief analysis

The long-term challenge would appear to have three distinct components - none of which is entirely straightforward.

1. Recruitment (of unqualified applicants for initial teacher training courses, and of already qualified teachers who are not currently teaching).
2. Retention (of those teachers already in post).
3. Re-training (of those teachers whose mathematical background is weak and who either wish to teach mathematics, or who are already being required to teach mathematics despite their limited background).

None of these is easy, and all are urgent! Moreover, they have to be tackled together. For example, as one correspondent put it: to address the first (for example) without the second is 'like trying to fill the bath without putting the plug in'.

Nevertheless I shall briefly consider each of the three separately - in reverse order.

3. Of the 40 000 or so mathematics teachers at Key Stages 3 and 4, official figures indicate that perhaps 25 000 need extensive mathematical retraining. If these teachers are to do their job with confidence, knowing where the mathematics they teach leads and why it is important, then a substantial national retraining programme is needed.

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Moreover, such a programme should be aimed at more than merely 'how to teach the national curriculum'.

Naturally such a re-training programme could also serve as a requirement for qualified teachers in other subjects who wish to re-train as mathematics teachers.

Given the lack of supply cover, such a programme could only be delivered during twilight sessions, during the vacations, or as part of a distance learning programme. Fortunately it is now possible to pay teachers to attend a series of such courses, to make the courses both demanding and rewarding, and to offer increments to successful participants as part of a coherent professional career structure.

It is essential that such courses deal with elementary mathematics in a way which guarantees competence in school mathematics, and which at the same time embeds the school mathematics to be taught in a larger context, so that teachers understand which approaches to particular topics offer the best long-term pay-off. Thus such courses need to be carefully planned and piloted (by suitable members of the mathematics and educational communities) before being rolled out and generally funded.

2. Retraining teachers with weak mathematical backgrounds could do much to increase the satisfaction they experience in their daily work, and so extend their careers. However, this is but one aspect of the requirement that we have to make schools 'more appealing places' for competent maths teachers to want to work in. Despite the (rather weak) claim in the recent white paper

> '7.8 It remains a priority to encourage good teachers to remain in the profession'

too many of the initiatives listed either miss the point, or look as though they will impose additional burdens on mathematics teachers. The central goal has to be to make things much simpler, so that maths teachers can concentrate on teaching mathematics better, with externally imposed disruption only where it is really needed. Thus classrooms need to be liberated from the bureaucratic stranglehold of recent years, so that teachers of proven competence can concentrate on teaching.

1. Recruitment to initial teacher training mathematics PGCE courses has fallen short of target for at least 10 years (and in 1998 dramatically so). Though preliminary numbers accepted for 2001 are up, they are still way below target replacement levels, and anecdotal evidence suggests that many of those who have applied to take a PGCE have little intention of ultimately going into teaching.

The medium-term challenge (given the serious shortage, the age-profile of mathematics teachers in post, and the need for more well-qualified entrants) is to find some way of recruiting 2000 or more PGCE mathematics students each year for an extended period.

The average number for the years 1991-2000 was 1270, so such a programme demands a massive increase.

Clearly it will take many years before any improvement in working conditions might help to increase recruitment. Hence we have to do more than simply wait and hope.

Moreover, training salaries and 'Golden hellos' may help to convince some of those who take not only a first look, but who pause long enough to get hold of, and absorb, the relevant information. But as strategies, they are too strongly focused on the individual. The scale of the problem is such that we have to adopt bolder, more systemic strategies, which enlist the help of institutions (such as universities), rather than depending on individual applicants.

I give four simple examples which, though not a complete solution, would help to change the culture in the most relevant undergraduate departments.

(i) University departments in highly numerate disciplines have to be encouraged to ensure (and should be rewarded for ensuring) that high quality presentations about the attractions of mathematics teaching are routinely made to their first and second year undergraduates as part of standard career information. These presentations should ideally be given by recent young recruits. It is not enough that such presentations take place 'somewhere on campus' - since only a small subset of those

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students who are almost committed are likely to find out about and attend such events. Presentations need to take place in the students' home department - preferably as part of some general provision that all students attend.

(ii) At present schemes which allow undergraduates to spend half a day each week in schools tend to be organised centrally within the university. To increase the number of participants in such schemes who come from mathematics departments, those departments should be encouraged to incorporate (and should be rewarded for incorporating) this activity - for credit - as a coherent part of some undergraduate module (see (iii)).

(iii) University departments cannot be expected to press students into considering teaching as a career. However, there remains a significant group of students who would consider teaching as a career if only they had the chance to think about mathematics as more than merely a technical discipline. Many of our students remember enjoying school mathematics in a way which does not easily transfer to lecture-based undergraduate courses. Many university mathematics departments have run modules which encourage second and third year students to take a broader view, and to reflect on the nature of mathematics. Some of these either consider explicitly such questions as how human beings learn mathematics, or provide scope for students to pursue such questions as part of a mini-project. Experience suggests that a significant number of those who take such courses discover an interest in teaching and go on to take a PGCE. Yet such courses are often harder to teach than ordinary lecture courses, and hard-pressed mathematics departments naturally view them as something of a luxury. Thus encouragement is needed if they are to keep such courses alive (see (iv)).

(iv) To encourage numerate university departments to take seriously the job of informing their students about mathematics teaching, individual departments should be given a substantial cash reward for each of their students who successfully completes a PGCE course. (Insofar as there is a visible correlation between this

unforced outcome and the kind of activities mentioned in (ii), or the kind of courses in (iii), departments would then be free to draw their own conclusions and to act accordingly.)

These proposals are serious, and would be very easy to implement. But they can only be part of the solution.

To increase the number of students entering PGCE mathematics courses - in a climate where industry and commerce already employ most of those who graduate in numerate disciplines - it has been clear for many years that there is no alternative but to deliberately work to increase the number of undergraduates in highly numerate disciplines! Yet this obvious requirement (which has many other advantages) has scarcely been discussed.

And to increase the number of students in highly numerate disciplines, there is clearly no alternative but to work systematically to increase the number of students taking, and succeeding at, A-level mathematics.

We can - and must - consider all kinds of lesser strategies (such as implementing (i)-(iv) above). Yet any serious attempt to tackle the problem - rather than fudge the issue - has to begin by increasing the pool of 18year olds with A-level mathematics.

To understand the extent of the current absence of debate between government and the profession, one need look no further than the AS/A2 fiasco. The botched introduction of AS levels was declared by those in Westminster as intended to increase the uptake of subjects like mathematics. Many of us warned that the opposite effect was more likely - and even explained why: but our predictions fell on deaf ears.

Reports from schools and colleges indicate unambiguously that the current structure has led to a marked decrease in those wanting to continue mathematics in Year 13.

What is needed is neither a fudge, nor pressure on exam boards to set trivial AS level exams or to lower the grade boundaries still further. The reality is that the kind of

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material that is best taught at A-level cannot be taught, assimilated and assessed within 8 months.

The whole structure needs review. And carved over the door of the review room should be the slogan: 'Let no proposal emerge from here unless it will increase the number of students succeeding at A-level mathematics.'

Of course, this central goal will require in turn an increase in the number of A-level mathematics teachers. So the overall strategy will have to include emergency measures to recruit (and train) appropriate teachers. This may prove expensive since the most likely recruits may be relatively 'senior': one may have to buy back some of those who have retired early, and to retrain mathematically competent recruits who take early retirement after other careers. But it should certainly be possible. And whatever it costs, it will be far cheaper than the inevitable consequences of continuing to bury our heads in the sand.

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